



Iain Baker
Manager – Environmental
Remediation

77 Beale Street, B28P
San Francisco, CA 94105
(415) 314-8530
ixbi@pge.com

May 29, 2020

Ms. Jan Zimmerman, PG
Ms. Shelby Barker, PG CHG
Ms. Amanda Lopez, PG
California Regional Water Quality Control Board,
Lahontan Region
15095 Amargosa Road, Bldg. 2, Suite 210
Victorville, California 92394

Subject: PGE-06 Freshwater Injection Pilot Test Results
Hinkley Compressor Station, Hinkley, California

Dear Ms. Zimmerman, Ms. Barker, and Ms. Lopez:

Enclosed is the Technical Memorandum PGE-06 Freshwater Injection Pilot Test Results, Hinkley Compressor Station, Hinkley, California for Pacific Gas and Electric Company's (PG&E's) Hinkley Site (Global Identification No. SL0607111288). This technical memorandum is being submitted to document the activities and monitoring results from the pilot test.

Freshwater injections at well PGE-06 took place between October 21, 2019 and March 31, 2020, and flow rates were generally maintained between 140 and 150 gallons per minute during injection testing. The hydraulic response at observation wells indicate that long-term freshwater injection at well PGE-06 could be an effective component of the remedial strategy for this part of the site by helping to reduce chromium concentrations and maintaining hydraulic control along the southeastern-chromium-plume boundary.

I certify, under penalty of perjury, in conformance with the laws of the State of California, that this technical memorandum is true, complete, and accurate, to the best of my knowledge.

Please call Iain Baker at (415) 314-8530 if you have any questions regarding this report.

Sincerely,

A handwritten signature in black ink, appearing to read 'Iain Baker', is written over a horizontal line.

Iain Baker
Hinkley Remediation Project Manager

Enclosure: PGE-06 Freshwater Injection Pilot Test Results
Hinkley Compressor Station, Hinkley, California

cc:

Patrice Copeland, Regional Water Quality Control Board Lahontan Region, Victorville office

MEMO

To:

California Regional Water Quality
Control Board, Lahontan Region

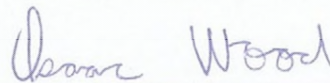
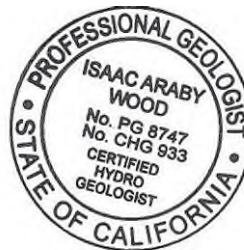
Copies:

Iain Baker, Pacific Gas and Electric
Company

Arcadis U.S., Inc.
101 Creekside Ridge Court
Suite 200
Roseville
California 95678
Tel 916 786 0320
Fax 916 786 0366

From:

Isaac Wood, PG CHG



Date:

May 29, 2020

Arcadis Project No.:

30035167

Subject:

PGE-06 Freshwater Injection Pilot Test Results
Hinkley Compressor Station, Hinkley, California

INTRODUCTION

Pacific Gas and Electric Company (PG&E) is remediating hexavalent chromium (Cr[VI]) in groundwater at the Hinkley Compressor Station in Hinkley, California under Cleanup and Abatement Order No. R6V-2015-0068 issued on November 4, 2015 (California Regional Water Quality Control Board, Lahontan Region [Water Board] 2015). In a workplan dated May 13, 2019 (Arcadis 2019), PG&E proposed to conduct a pilot test for freshwater injection into existing former PG&E supply well PGE-06 located southeast of the chromium plume boundary (Figure 1). The objective of the freshwater injection pilot test was to assess whether longer term freshwater injection in this area may be an additional remedial alternative to consider for future enhancement of hydraulic containment and clean water flushing along the southeastern plume boundary to reduce chromium concentrations in this area.

Additionally, hydraulic data obtained from the pilot test were anticipated to yield valuable insight into the hydraulic influence of the Lockhart Fault system in this area, providing a basis for the optimization of current and future remedial activities. An improved understanding of the Lockhart Fault system was initially revealed in a study by Dave Miller at the United States Geological Survey (USGS) as part of the USGS's

chromium background study. The USGS study indicates that there are numerous other splays of the Lockhart Fault system present throughout the southern plume area (Miller et al., 2018), in addition to the primary fault splay depicted on Figure 1. The hydrogeologic influences of these newly identified fault splays within the plume core areas, containing the highest chromium concentrations on site, are just beginning to be understood. As the USGS fault splay study is finalized upon completion of the chromium background study the freshwater pilot test data will be evaluated considering this additional information.

TEST IMPLEMENTATION

PG&E received Water Board approval in an email dated July 19, 2019 (Water Board 2019a) to conduct a 2-month pilot test. Freshwater injection into supply well PGE-06 began on October 21, 2019 and continued until November 24, 2019. Freshwater injection resumed on December 11, 2019 after the initial data were evaluated. Subsequently, PG&E requested approval from the Water Board to extend the pilot test to further the understanding of the potential benefits of long-term freshwater injection in this area (PG&E 2019). The Water Board approved PG&E's request in an email dated December 16, 2019 (Water Board 2019b), and freshwater injection continued until March 31, 2020.

Injections occurred solely in the Upper Aquifer into well PGE-06, screened from 50 to 118 feet below ground surface (Table 1). Freshwater injection flow rates during the pilot test ranged from 24 to 159 gallons per minute (gpm). Flow rates of approximately 140 and 150 gpm were maintained during most of the testing period. A total of approximately 28.7 million gallons of freshwater were injected over both periods of freshwater injection. PGE-13 was identified as a potential secondary pilot test injection well in the workplan (Arcadis 2019); however, PGE-13 was not used as an injection well during this pilot test but rather was used as an observation well to monitor hydraulic response as discussed below.

Well PGE-06 injection water during the pilot test was primarily sourced from freshwater supply wells FW-03 and FW-04 located approximately 1 mile southeast of the compressor station near Dixie and Highcrest Roads (Arcadis 2020). Standby freshwater supply wells FW-01 and FW-02 located south of the PG&E compressor station (Figure 1) were also operated briefly during the pilot testing period for pump maintenance and groundwater sample collection. Freshwater supply wells FW-03 and FW-04 (and occasionally FW-01 and FW-02) are also used to supply freshwater for the Northwest Freshwater Injection system, where freshwater is injected in up to six injection wells near continuously to enhance hydraulic containment of the northwestern portion of the chromium plume (Arcadis 2020). Injection of freshwater from wells FW-01, FW-02, FW-03 and FW-04 into the Northwest Freshwater Injection system is permitted under a Notice of Applicability (Water Board 2016). Table A-1 of the Notice of Applicability Water specifies that the following constituents are analyzed semiannually for freshwater supply wells FW-01, FW-02, FW-03 and FW-04:

- Cr(VI) by United States Environmental Protection Agency (USEPA) Method 218.6
- Total chromium, dissolved arsenic, and dissolved manganese by USEPA Method SW 6020
- Dissolved iron by USEPA Method SW 6010B
- Total dissolved solids by Standard Method 2540C
- Nitrate as nitrogen and sulfate by USEPA Method 400.0
- Dissolved sulfate by USEPA Method 300.0
- Uranium by USEPA Method 200.8
- Gross alpha by USEPA Method 900.0

- Field parameters.

Freshwater supply well water quality results for supply wells FW-01, FW-02, FW-03 and FW-04 are provided as Attachment 1. There were no exceedances of applicable water quality standards in the freshwater source that would require well head treatment before injection into well PGE-06.

PG&E extraction well EX-66 is the nearest extraction well that was in operation during the pilot test (Figure 1). Extraction well EX-66 is located within the chromium plume and is 592 feet away from well PGE-06. Extraction flow rates at well EX-66 averaged approximately 10 gpm when active during the testing period. Extraction well EX-66 was inactive from February 27 through March 11, 2020 to evaluate the influence of freshwater injection without extraction occurring at this well. Extraction well EX-67 is the next closest PG&E extraction well and it is located approximately 1,695 feet away from well PGE-06, also within the chromium plume. Extraction well EX-67 was active for the entire duration of the pilot test and extraction flow rates averaged approximately 49 gpm.

Monitoring of the groundwater level draw-up in active injection well PGE-06 was regularly measured during the pilot test, and totalizer readings were also recorded to document the injected volumes and estimate injection rates (Figures 2 through 12). Hydraulic response to freshwater injection during pilot test was monitored using pressure transducers in observation wells shown on Figure 1 (locations highlighted in orange) during the pilot test period, as discussed below.

HYDRAULIC RESPONSE

Pressure transducers in observation wells recorded data every 30 minutes during the test period to monitor hydraulic response. Hydrographs of the pressure transducer data with the injection and extraction well flow rate data were prepared to assess the magnitude of the mounding created by injection and are provided on Figures 2 through 12. Well construction information and the distances of the observation wells to well PGE-06 are summarized in Table 1. The groundwater elevation at well PGE-06 before the start of injection on October 21, 2019 was 2,110.30 feet above mean sea level (amsl). For most of the injection testing, injection flow rates were maintained between approximately 140 and 150 gpm. The corresponding groundwater elevation at these flow rates was approximately 2,134 feet amsl (middle panel Figure 2), representing approximately 24 feet of draw-up within well PGE-06.

As shown on Figure 2, the greatest hydraulic response to freshwater injection into well PGE-06 was observed 453 and 840 feet south of well PGE-06 injection at former PG&E supply wells PGE-13 and PGE-12, respectively. Both wells are located on the northeast side of the Lockhart Fault (the same side as well PGE-06) but generally closer to the fault splay than other observation wells monitored during testing. Well PGE-13 is screened across both the Upper and Lower Aquifers; therefore, a packer was placed in the well before initiating injection into well PGE-06. Well PGE-12 is also screened across both the Upper and Lower Aquifers, but a packer was not placed within the well for the pilot test. All other observation locations were screened within the Upper Aquifer (like well PGE-06). At well PGE-13, an initial period of groundwater elevation increase occurred several days after well PGE-06 injection began and continued until November 26, 2019, 2 days following the suspension of well PGE-06 injection. At well PGE-13, a period of relatively slow groundwater elevation decline occurred while injection was suspended at well PGE-06 (November 24 to December 11, 2019). When well PGE-06 injection was resumed at approximately 150 gpm, well PGE-13 water levels continued to increase. The rate of groundwater elevation increase at well PGE-13 during the second period of injection at well PGE-06 was generally similar to the first period of injection, until PGE-13 water levels appeared to approach equilibrium with steady groundwater levels over the final 2 weeks of the pilot test.

Meanwhile, the groundwater elevation at well PGE-12 increased at a relatively consistent rate throughout the entire duration of the pilot test and did not decrease during the period of inactive well PGE-06 injection. Before well PGE-06 injection began, the groundwater elevation at well PGE-13 was approximately 0.5 foot greater than at well PGE-12. The hydraulic head difference increased during injection until early March when a maximum head difference of approximately 1.75 feet developed. Groundwater levels at well PGE-12 appeared to be reaching equilibrium over the final week of the pilot test.

Figure 3 shows that a hydraulic response to well PGE-06 injection may have been observed 1,562 feet southwest at inactive supply well FW-01, where the water level increased nearly 0.25 foot between the beginning and end of the pilot test. However, water levels did not increase through the duration of the pilot test at FW-02 which is located 1,423 feet south of well PGE-06 and 281 feet east of well FW-01. Both inactive supply wells are located on the southwest side of the Lockhart Fault.

Monitoring wells BW-01S and BW-01D are 484 feet northwest of well PGE-06 and within the southeastern-chromium-plume boundary (Figure 1). These wells are influenced by well EX-66 extraction and were also influenced by well PGE-06 injection during the pilot test. As shown on Figure 4, the groundwater elevations at wells BW-01S and BW-01D increased approximately 3 feet throughout the pilot test. Groundwater levels were still rising when the pilot test ended. The BW-01S/D well pair is located 108 feet southeast of Source Area extraction well EX-66, and both the shallow and deep interval are influenced by well EX-66 extraction operations. Well EX-66 extracted groundwater at approximately 15 gpm from October 1 until October 15, 2019 when flow rates were reduced to approximately 10 gpm and were generally maintained at the reduced flow rate for the remainder of the test. Well EX-66 extraction was suspended from February 27 through March 11, 2020, and groundwater levels increased approximately 1.0 and 1.5 feet at BW-01S and BW-01D, respectively during this period. When extraction resumed at well EX-66, groundwater elevations at wells BW-01S and BW-01D were drawn down but continued the overall increasing groundwater elevation trend observed throughout the duration of the pilot test.

As shown on Figure 5, evidence of hydraulic influence from the pilot test was not observed at southeast Source Area shallow-zone monitoring well MW-39, located approximately 707 feet northwest of well PGE-06. The pressure transducer at monitoring well MW-39D malfunctioned on December 2, 2019; therefore, limited data were available during the pilot test. Like the BW-01S/D well pair, well MW-39 is influenced by extraction at well EX-66. Well EX-66 is located 115 feet southeast of well MW-39 (Figure 1). Extraction at well EX-66 likely dampened any hydraulic effect well PGE-06 injection might have had on water levels at well MW-39 during the pilot test.

As shown on Figure 6, groundwater elevations at southeast Source Area deep-zone monitoring well MW-217D followed a consistent increasing trend, rising approximately 1.5 feet through the duration of the pilot test. Meanwhile, the shallow-zone interval at well MW-217S did not show evidence of hydraulic influence from injection at well PGE-06. As detailed in the 2018 Source Area Investigation Work Plan submitted on January 3, 2018 (Arcadis 2018), a lower-permeability layer appears to separate the screened intervals at wells MW-217S and MW-217D. The different hydraulic responses to injections at well PGE-06 observed at wells MW-217S and MW-217D is consistent with the interpretation that the lower-permeability layer at least partially isolates the deep zone from the shallow zone in this area and that well PGE-06 is partially screened across this semiconfined deeper layer.

As shown on Figures 7 and 8, evidence of hydraulic influence from well PGE-06 injections was not observed in the shallow or deep zone observation wells (SA-MW-27SR, SA-MW-27D, SA-MW-34S, and MW-46M) located 900 feet or more north of well PGE-06. Groundwater levels at these locations declined through the pilot testing period, consistent with other site wells in this area where drought conditions are resulting in widespread declining groundwater levels. However, as shown on Figure 8, groundwater

elevations at Source Area deep-zone monitoring well SA-MW-34D followed a consistent increasing trend, rising approximately 1 foot through the duration of the pilot test. A vertical gradient reversal occurred in mid-March with water levels in well SA-MW-34D crossing well SA-MW-34S where declining groundwater levels were observed during the pilot test. The different hydraulic responses to injections at well PGE-06 at these wells is also consistent with the interpretation of a lower-permeability layer that partially isolates the deep zone from the shallow zone in this area and that well PGE-06 is partially screened across this semiconfined deeper layer.

As shown on Figures 9 through 12, overall decreasing groundwater elevations were also observed throughout the duration of the pilot test east and southeast of the chromium plume at piezometers PZ-16A/B through PZ-19A/B, with the exception of piezometer PZ-18B (Figure 11). Piezometer PZ-18B is located 1,633 feet southeast of well PGE-06, and groundwater levels increased approximately 2 feet during the pilot test and appeared to be reaching equilibrium over the final week of the pilot test. Piezometer PZ-18B groundwater elevations were relatively consistent near 2,111 feet amsl from October 1, 2019 until late-October when PGE-06 injection began, and then water levels began increasing (Figure 11). Piezometer PZ-18B water levels appeared to begin equilibrating at just greater than 2,113 feet amsl in mid-March when PGE-06 injection was maintained at approximately 140 gpm. The differing hydraulic response during the pilot test at piezometers PZ-18A and PZ-18B and upward-vertical gradients that exist between the piezometer screens without freshwater injection occurring (approximately 10 feet) indicate the likely presence of a lower-permeability layer separating the screened intervals.

SUMMARY

Freshwater injection at PGE-06 took place over two periods between October 21, 2019 and March 31, 2020. Average injection flow rates were generally maintained between 140 and 150 gpm. A maximum of 24.48 feet of water-level draw-up during injection was observed at the injection well during the pilot test. During the pilot test, groundwater elevations increased in southeastern Source Area monitoring wells BW-01S, BW-01D, MW-217D, and SA-MW-34D, which are generally located within the southeastern-chromium-plume boundary. These data indicate that future injection at well PGE-06 may be an effective component of the broader remedial strategy for this part of the site to help reduce chromium concentrations via clean water flushing while maintaining hydraulic control along the southeastern boundary of the chromium plume. Wells screened across semi-confined zones in the deep zone of the Upper Aquifer (such as piezometer PZ-18B and well MW-217D located 1,633 and 1,121 feet from well PGE-06, respectively) showed a greater response to injection than shallow monitoring wells at these locations, indicating that well PGE-06, which is fully screened across the Upper Aquifer, is in hydraulic communication with these deeper semi-confined zones of the Upper Aquifer.

REFERENCES

- Arcadis. 2018. Source Area Investigation Workplan, MW-01 Area, Pacific Gas and Electric Company (PG&E), Hinkley Compressor Station, Hinkley, California. January 3.
- Arcadis. 2019. Workplan for Freshwater Injection Pilot Test to Evaluate Potential Hydraulic Containment Contingency Alternative for Southeast Chromium Plume Boundary, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. May 13.
- Arcadis. 2020. First Quarter of 2020 Monitoring Report for the In Situ Reactive Zone and the Northwest Freshwater Injection Projects, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California, California Regional Water Quality Control Board, Lahontan Region. Order No. R6V-2008-0014 (Waste Discharge Requirements Identification No. 6B369107001). April 30.

- Miller D.M, et al. 2018. Middle Pleistocene infill of Hinkley Valley by Mojave River sediment and associated lake sediment: Depositional architecture and deformation by strike-slip faults. Desert Symposium <http://www.desertsymposium.org/2018%20DS%20Against%20the%20Current.pdf>
- PG&E. 2019. Email from I. Baker to J. Zimmerman (Water Board) re: Request to Extend Duration of Freshwater Injection Pilot Test. December 16.
- Water Board. 2015. Cleanup and Abatement Order No. R6V-2015-0068 Requiring PG&E to Cleanup and Abate Waste Discharges of Total and Hexavalent Chromium to the Groundwaters of the Mojave Hydrologic Unit, PG&E Compressor Station, Hinkley, San Bernardino County. November 4.
- Water Board. 2016. Issuance of a New Notice of Applicability of General Waste Discharge Requirements for in-Situ Remediation Zones and the Northwest Freshwater Injection System (Board Order No. R6V-2008-0014), Pacific Gas and Electric Company's Hinkley Compressor Station, San Bernardino County. April 20.
- Water Board. 2019a. Email from J. Zimmerman to I. Baker (PG&E) re: PG&E Hinkley: Potential Freshwater Injection Pilot Test. July 19.
- Water Board. 2019b. Email from J. Zimmerman to I. Baker (PG&E) re: RE: Request to Extend Duration of Freshwater Injection Pilot Test. December 16.

Table

Table 1 Well Construction Details and Pilot Test Results Summary

Figures

Figure 1 Hydraulic Response Monitoring Locations

Figure 2 Hydraulic Response Monitoring at PGE-12 and PGE-13

Figure 3 Hydraulic Response Monitoring at FW-01 and FW-02

Figure 4 Hydraulic Response Monitoring at BW-01S and BW-01D

Figure 5 Hydraulic Response Monitoring at MW-39 and MW-39D

Figure 6 Hydraulic Response Monitoring at MW-217S and 217D

Figure 7 Hydraulic Response Monitoring at MW-46M, SA-MW-27SR, and SA-MW-27D

Figure 8 Hydraulic Response Monitoring at SA-MW-34S and SA-MW-34D

Figure 9 Hydraulic Response Monitoring at PZ-16A and PZ-16B

Figure 10 Hydraulic Response Monitoring at PZ-17A and PZ-17B

Figure 11 Hydraulic Response Monitoring at PZ-18A and PZ-18B

Figure 12 Hydraulic Response Monitoring at PZ-19A and PZ-19B

Attachment

Attachment 1 FW-01 Through FW-04 Water Supply Well Analytical Results

TABLE



Table 1
Well Construction Details and Pilot Test Results Summary
PGE-06 Freshwater Injection Pilot Test Results
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well ID	Depth to Top of Screened Interval (ft bgs)	Depth to Bottom of Screened Interval (ft bgs)	Screened Interval Length (ft)	Casing Diameter (in)	Aquifer Designation	Borehole Depth (ft bgs)	Distance from PGE-06 (ft)	Evidence of Hydraulic Response to PGE-06 injections?
PGE-06	50	118	68	14	Upper Aquifer	150	0	Yes
PGE-13	75-135	215- 255	180	8	Upper & Lower Aquifer	260	453	Yes
EX-66	90	130	40	6	Upper Aquifer	135	592	--
EX-67	97-117	127-137	30	6	Upper Aquifer	135	1,695	--
BW-01S	84	104	20	4	Shallow Zone, Upper Aquifer	104	484	Yes
BW-01D	109	129	20	2.5	Deep Zone, Upper Aquifer	129	484	Yes
MW-39	91.4	101.4	10	4	Shallow Zone, Upper Aquifer	101.9	707	No
MW-39D	105	120	15	2.5	Deep Zone, Upper Aquifer	123.2	736	--
PGE-12	90-120	150-170; 210-245	85	8	Upper & Lower Aquifer	245	840	Yes
SA-MW-27D	107	117	10	2.5	Deep Zone, Upper Aquifer	117	949	No
SA-MW-27SR	89	104	15	4	Shallow Zone, Upper Aquifer	110	961	No
MW-217S	88	103	15	4	Shallow Zone, Upper Aquifer	103	1,106	No
MW-217D	110	120	10	2.5	Deep Zone, Upper Aquifer	120	1,121	Yes
SA-MW-34S	83	98	15	4	Shallow Zone, Upper Aquifer	98	1,301	No
SA-MW-34D	109	119	10	2.5	Deep Zone, Upper Aquifer	119	1,302	Yes
MW-46M	96	111	15	4	Shallow Zone, Upper Aquifer	111	1,331	No

Table 1
Well Construction Details and Pilot Test Results Summary
PGE-06 Freshwater Injection Pilot Test Results
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well ID	Depth to Top of Screened Interval (ft bgs)	Depth to Bottom of Screened Interval (ft bgs)	Screened Interval Length (ft)	Casing Diameter (in)	Aquifer Designation	Borehole Depth (ft bgs)	Distance from PGE-06 (ft)	Evidence of Hydraulic Response to PGE-06 injections?
FW-02	77.5	107.5	30	8.625	Shallow Zone, Upper Aquifer	112.5	1,423	No
FW-01	80	110	30	8.625	Shallow Zone, Upper Aquifer	115	1,562	Yes
PZ-18B	122	132	10	2.5	Deep Zone, Upper Aquifer	150	1,633	Yes
PZ-18A	95	110	15	4	Shallow Zone, Upper Aquifer	150	1,661	No
PZ-17A	98	113	15	4	Shallow Zone, Upper Aquifer	150	1,938	No
PZ-17B	128	138	10	2.5	Deep Zone, Upper Aquifer	150	1,958	No
PZ-19B	124.5	134.5	10	2.5	Deep Zone, Upper Aquifer	150	2,534	No
PZ-19A	95	110	15	4	Shallow Zone, Upper Aquifer	150	2,546	No
PZ-16A	92	107	15	4	Shallow Zone, Upper Aquifer	143	2,634	No
PZ-16B	128	138	10	2.5	Deep Zone, Upper Aquifer	143	2,652	No

Notes:

-- = EX-66 and EX-67 are active extraction wells, not hydraulic monitoring locations, and the pressure transducer at MW-39D failed on December 2, 2019; therefore, limited data were available during the pilot test.

bgs = below ground surface

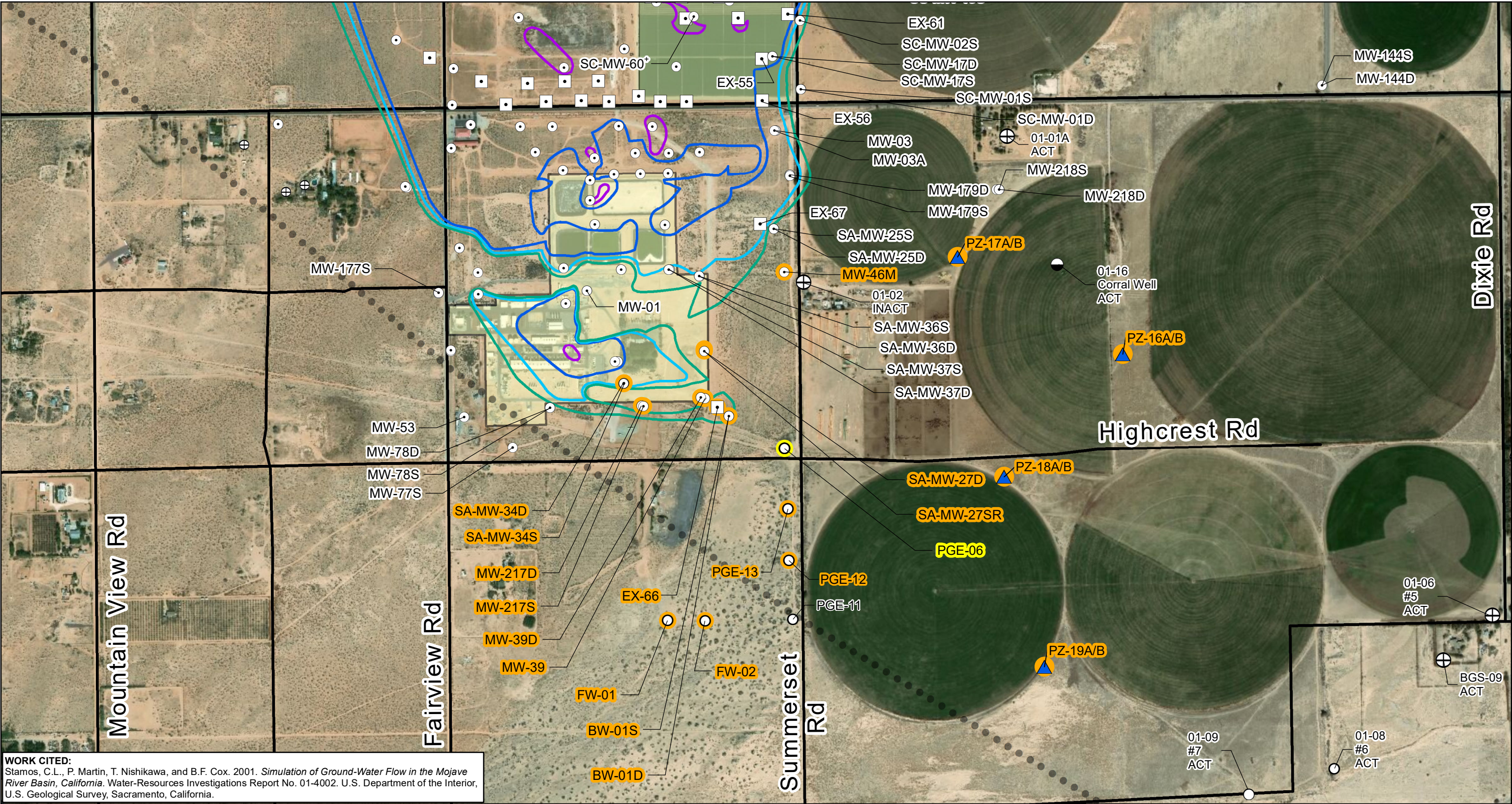
ft = foot

ID = identification

in = inch

FIGURES





WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. Water-Resources Investigations Report No. 01-4002. U.S. Department of the Interior, U.S. Geological Survey, Sacramento, California.

LEGEND:

- Monitoring Well
- Groundwater Extraction Well
- Piezometer
- Wells in PGE database**
- Other Supply Well
- Agricultural Supply Well
- Domestic Supply Well
- PG&E Compressor Station
- Agricultural Treatment Unit (ATU)

- Approximate outline of Cr(VI) or Cr(T) concentrations in Upper Aquifer exceeding values of 3.1 and 3.2 µg/L, respectively, First Quarter 2020 (Dashed where inferred)
- Approximate 10 µg/L outline of Cr(VI) or Cr(T) concentrations in Upper Aquifer, First Quarter 2020 (Dashed where inferred)
- Approximate 50 µg/L outline of Cr(VI) or Cr(T) concentrations in Upper Aquifer, First Quarter 2020
- Approximate 1,000 µg/L outline of Cr(VI) or Cr(T) concentrations in Upper Aquifer, First Quarter 2020

- Approximate Location of Lockhart Fault; Fault Trace is Inferred, and There is No Surface Expression (Stamos et al. 2001)
- BW-01D** Hydraulic Response Monitoring Location
- PGE-06** Freshwater Injection Pilot Test Well
- + Location is Approximate, Survey Pending

ABBREVIATIONS:
µg/L Micrograms per Liter
Cr(VI) Hexavalent Chromium
Cr(T) Total Dissolved Chromium

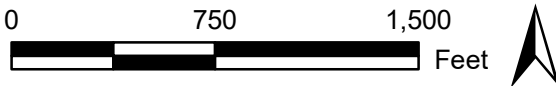
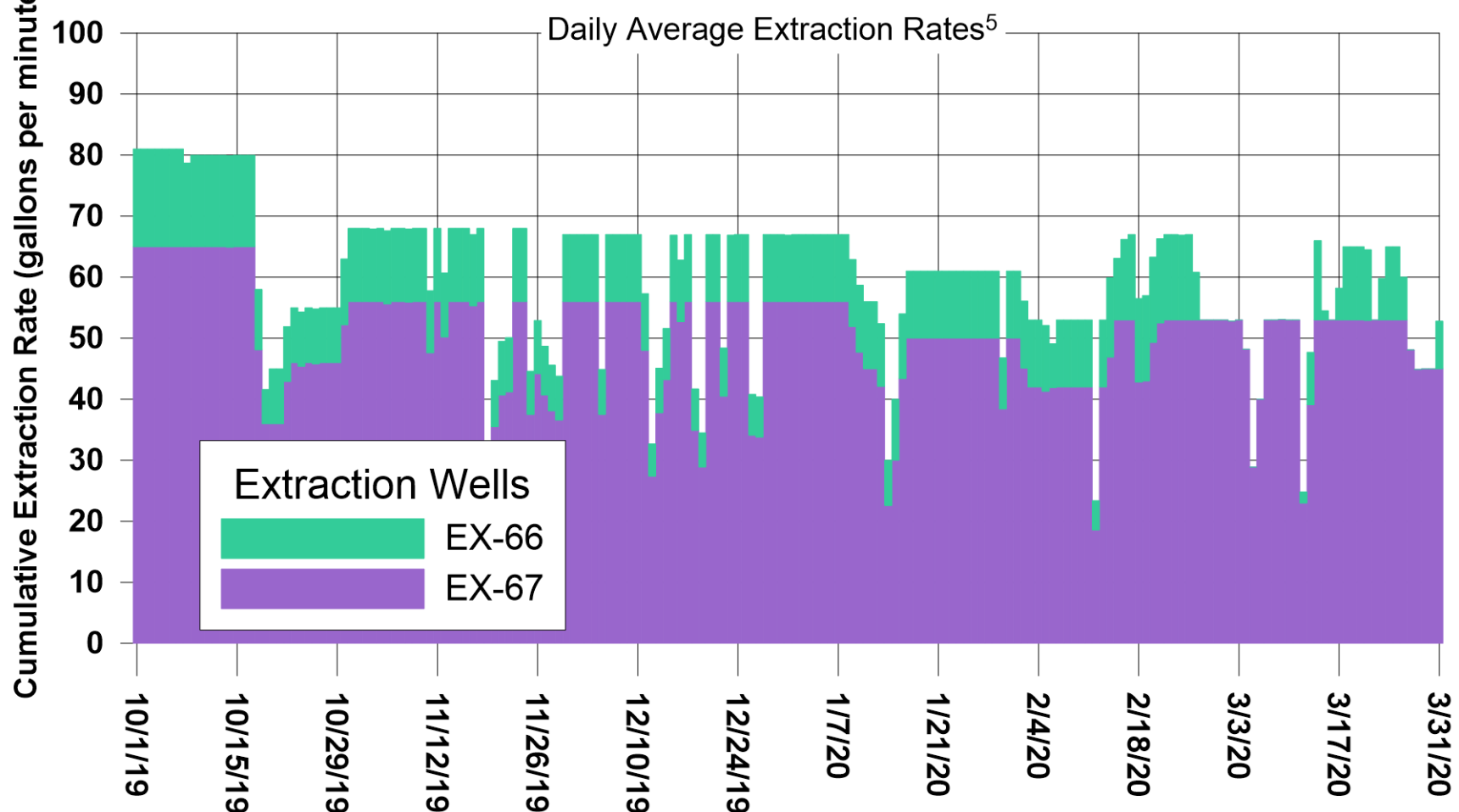
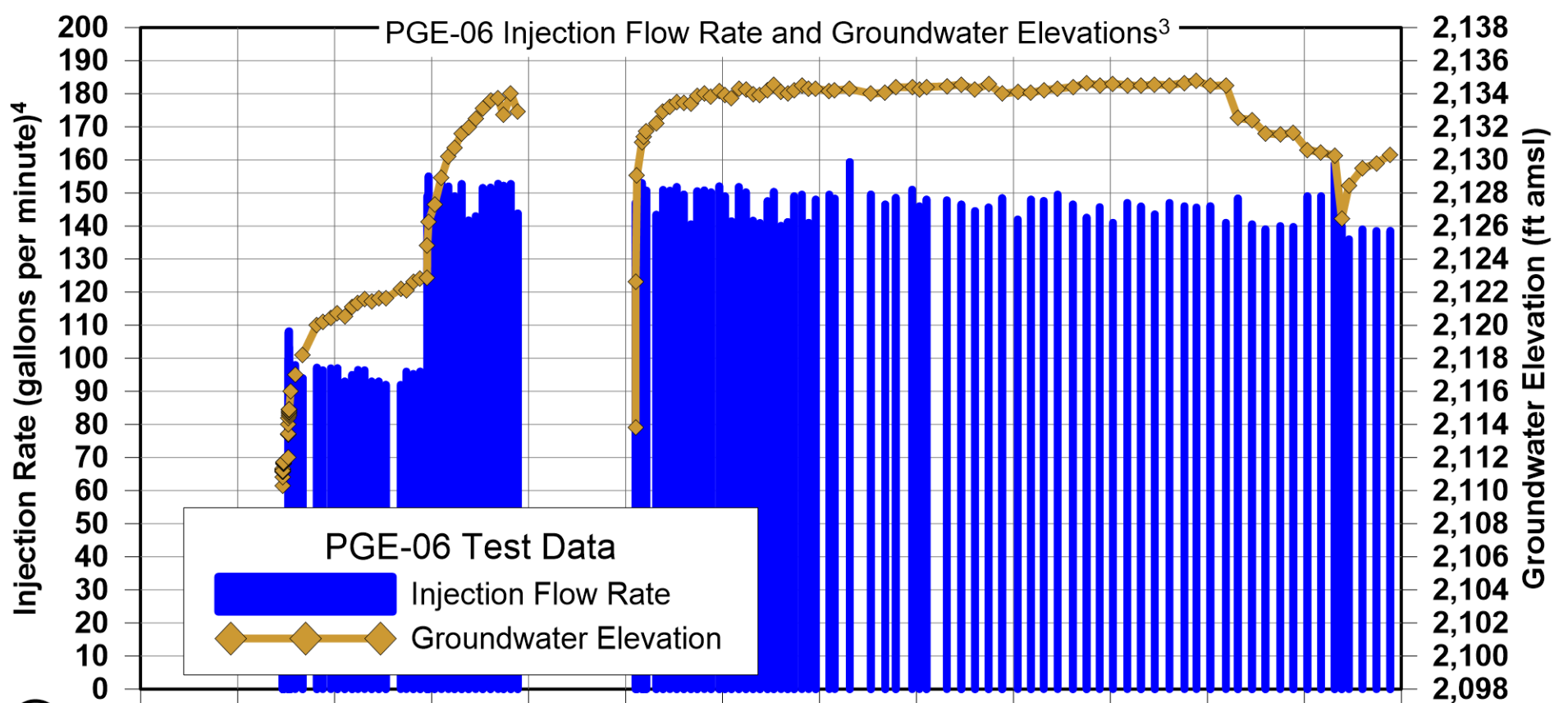
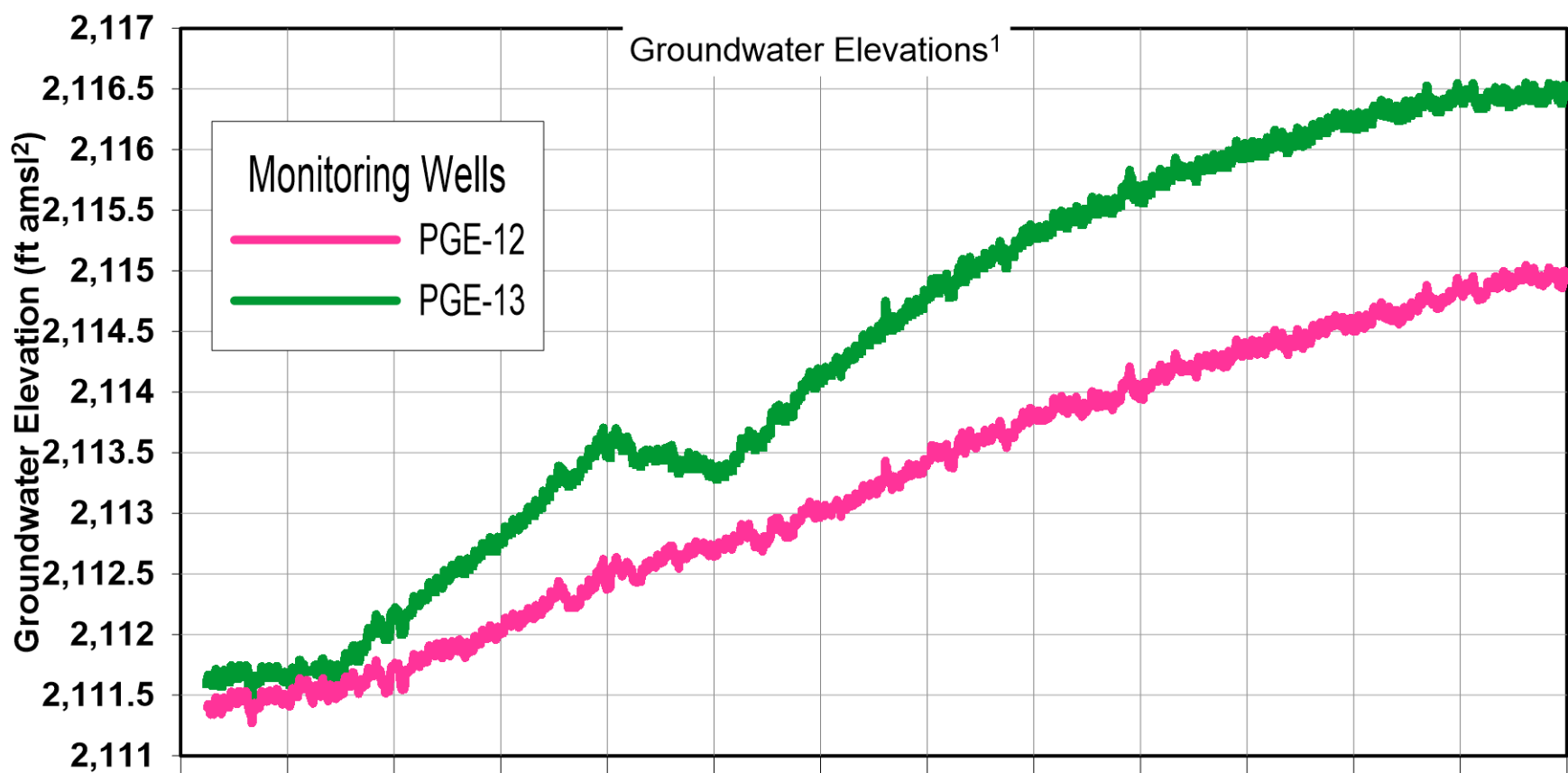


FIGURE 1
HYDRAULIC RESPONSE MONITORING LOCATIONS
PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA
ARCADIS Design & Consultancy for natural and built assets



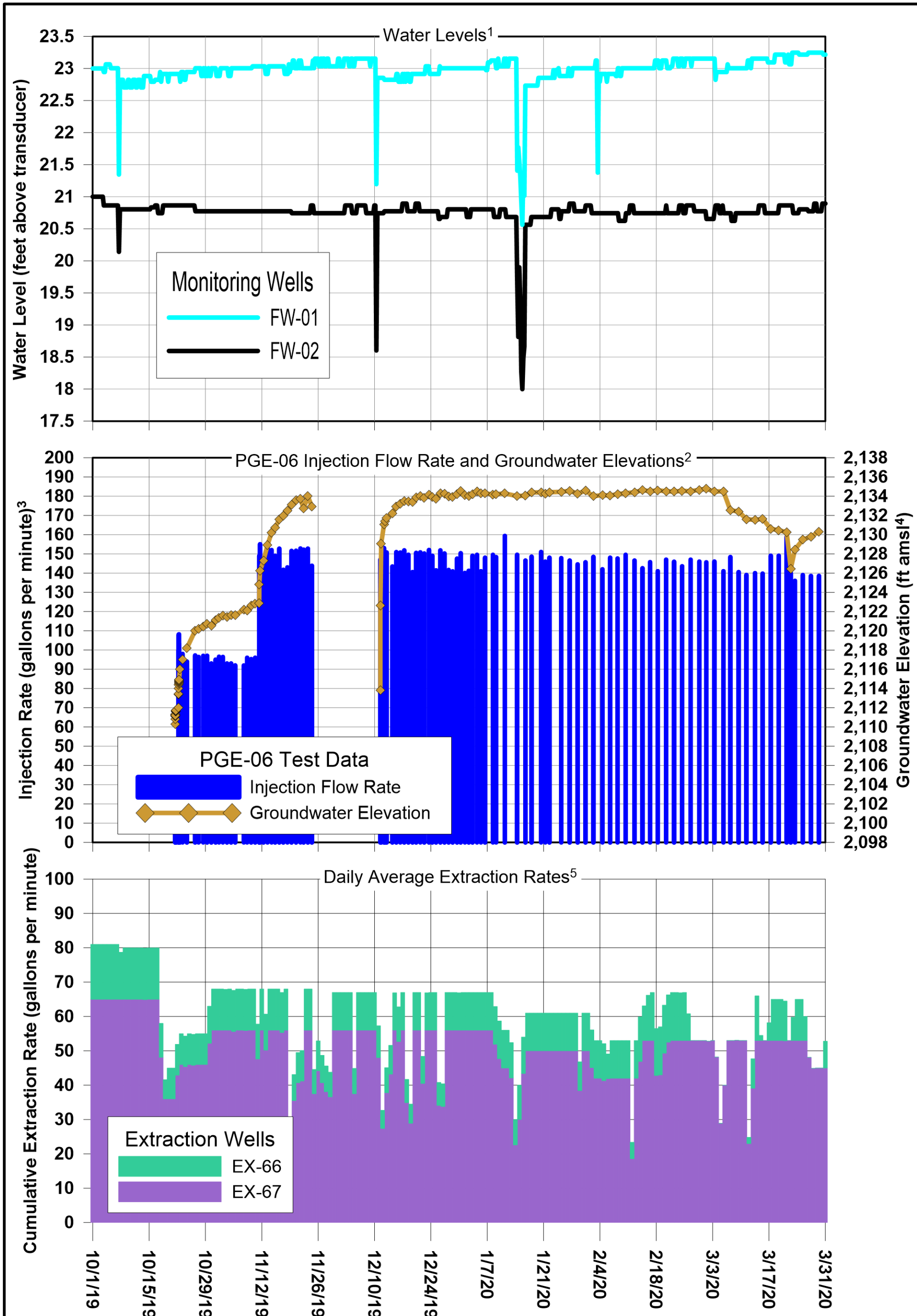
Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft ASML: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 2

Hydraulic Response Monitoring at PGE-12 and PGE-13

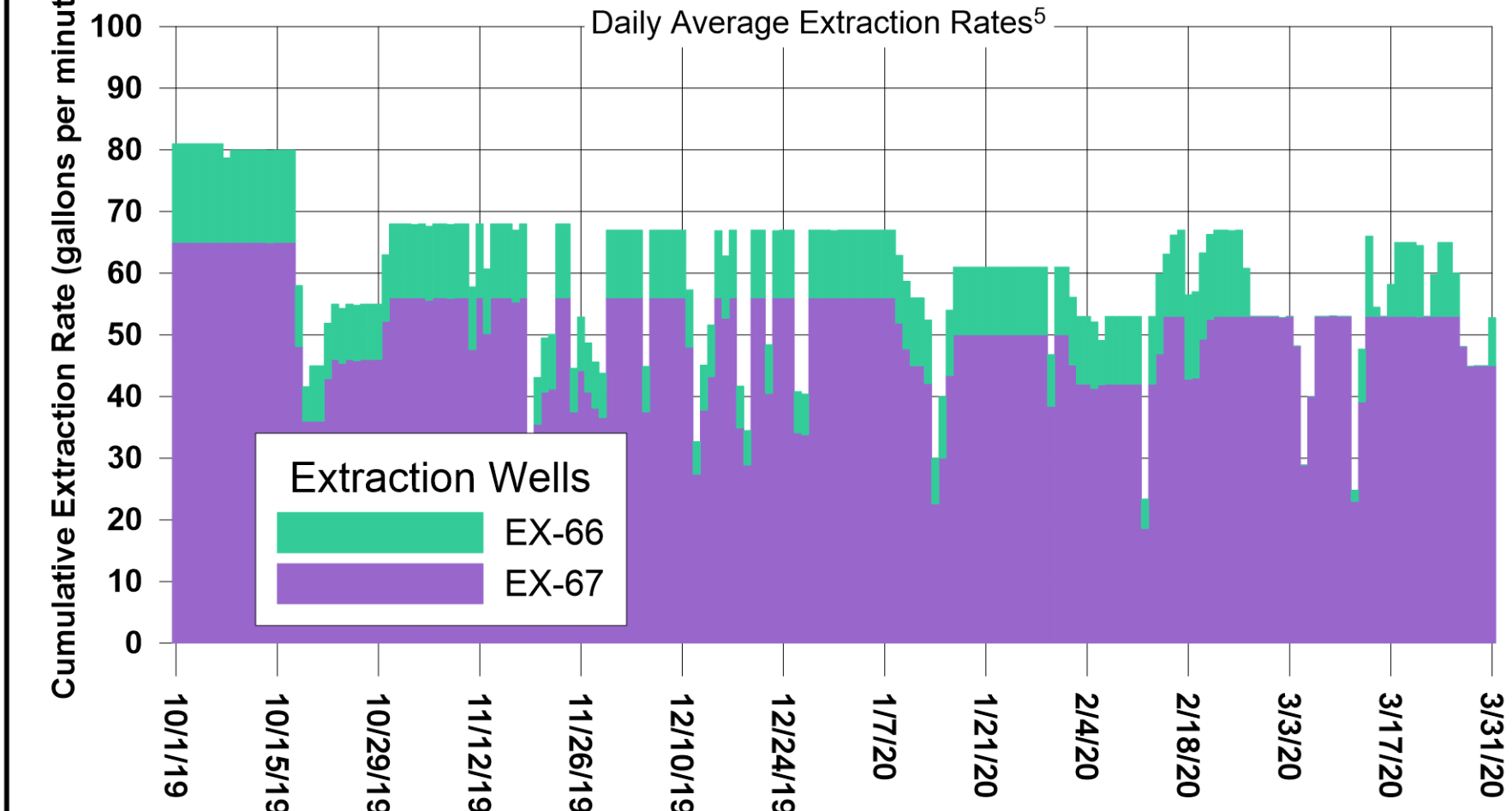
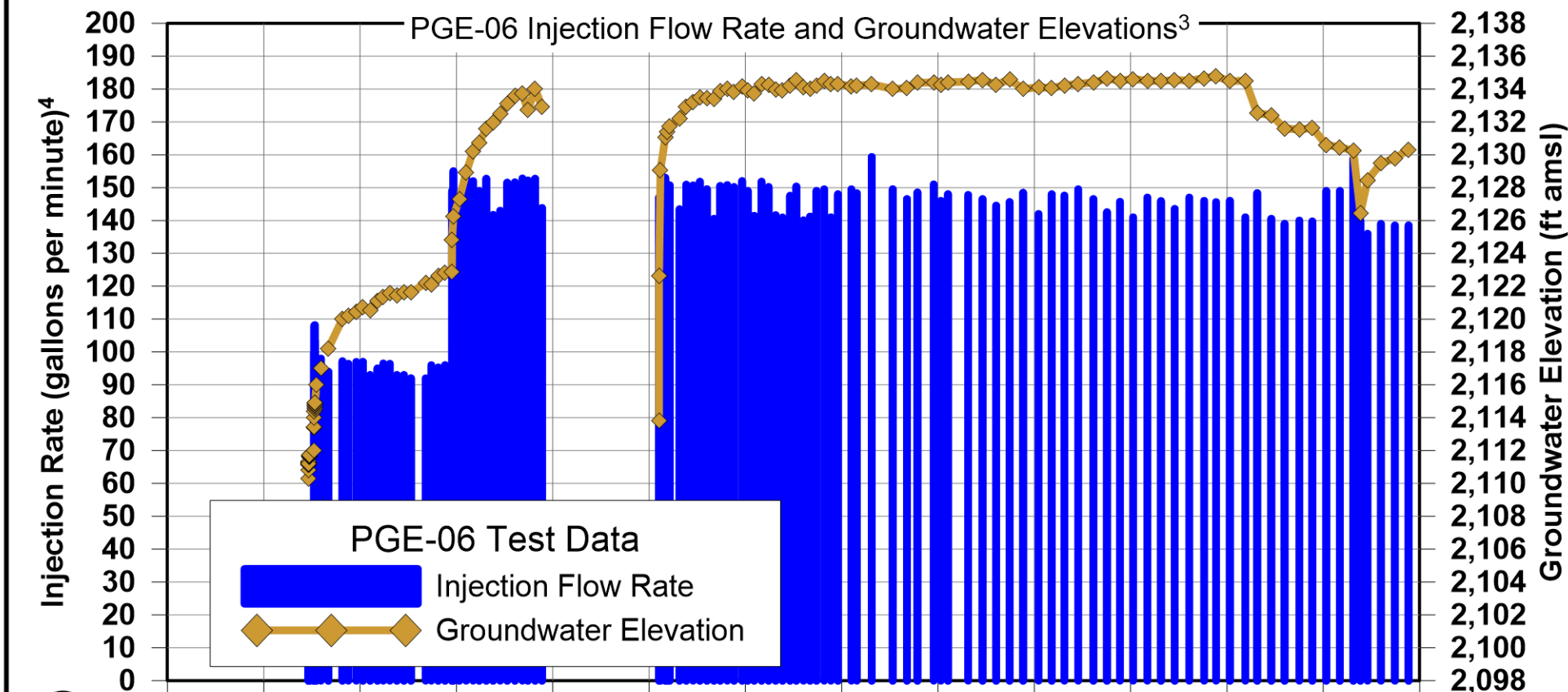
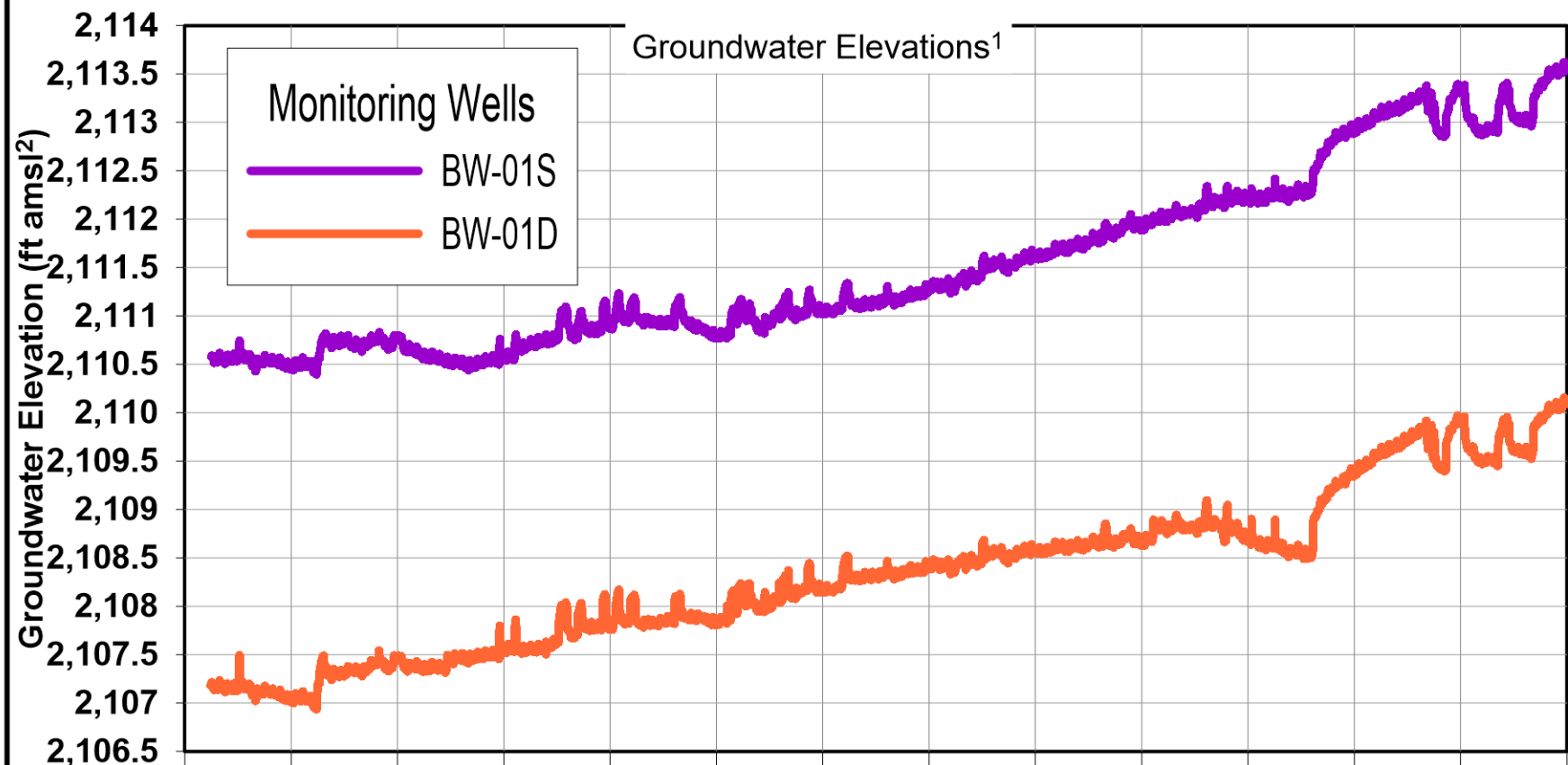
PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
PACIFIC GAS & ELECTRIC COMPANY,
HINKLEY COMPRESSOR STATION,
HINKLEY CALIFORNIA



Notes:

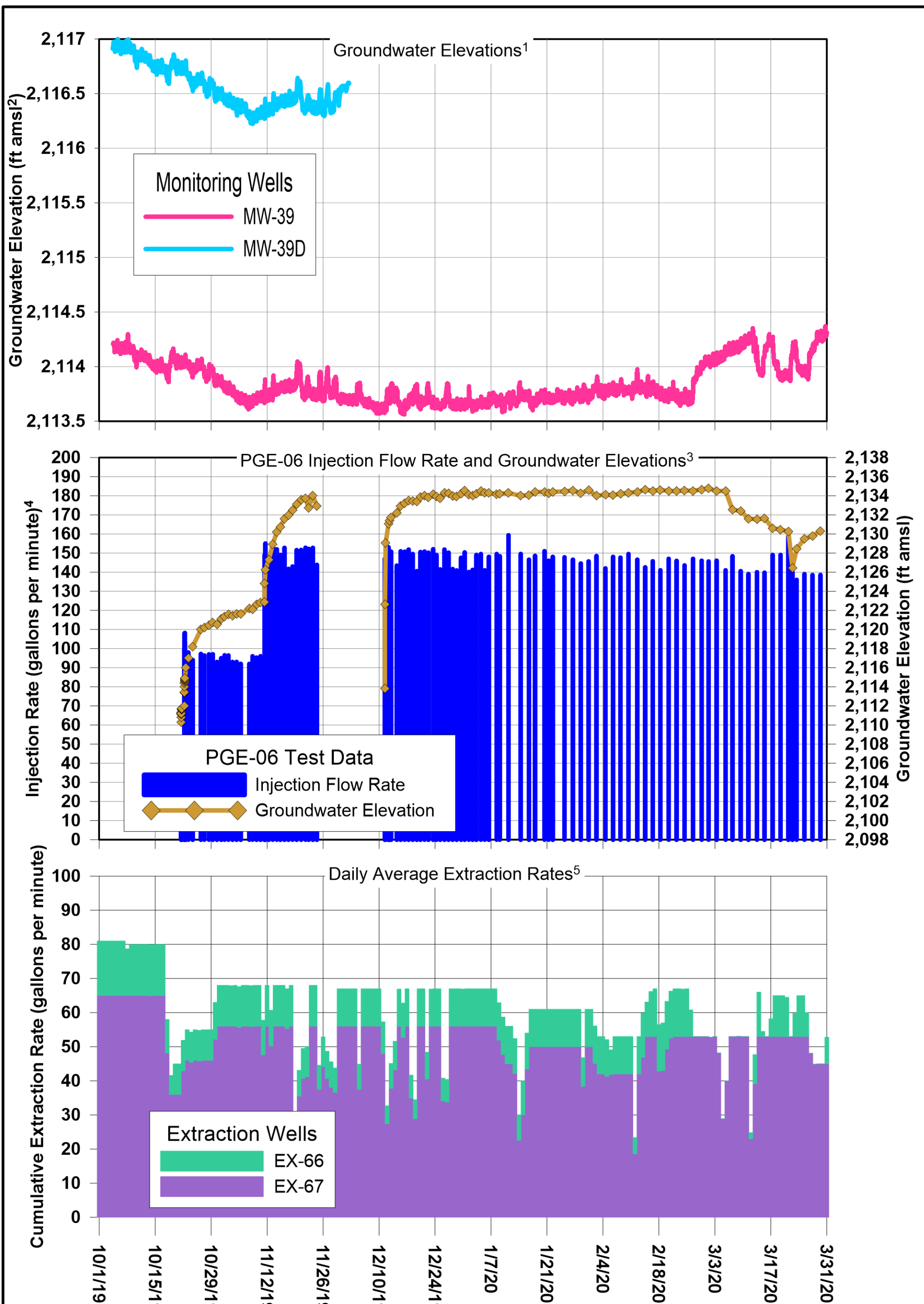
- 1) Data are measurements from pressure transducers recorded every 6 hours using supervisory control and data acquisition.
- 2) PGE-06 groundwater elevations are manual measurements.
- 3) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 4) ft amsl: Feet Above Mean Sea Level
- 5) Data are daily average flow rates for extraction wells recorded and calculated using Supervisory Control and Data Acquisition.

Figure 3
Hydraulic Response Monitoring
at FW-01 and FW-02
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



- Notes:**
- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
 - 2) ft amsl: Feet Above Mean Sea Level
 - 3) PGE-06 groundwater elevations are manual measurements.
 - 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
 - 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 4
Hydraulic Response Monitoring
at BW-01S and BW-01D
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



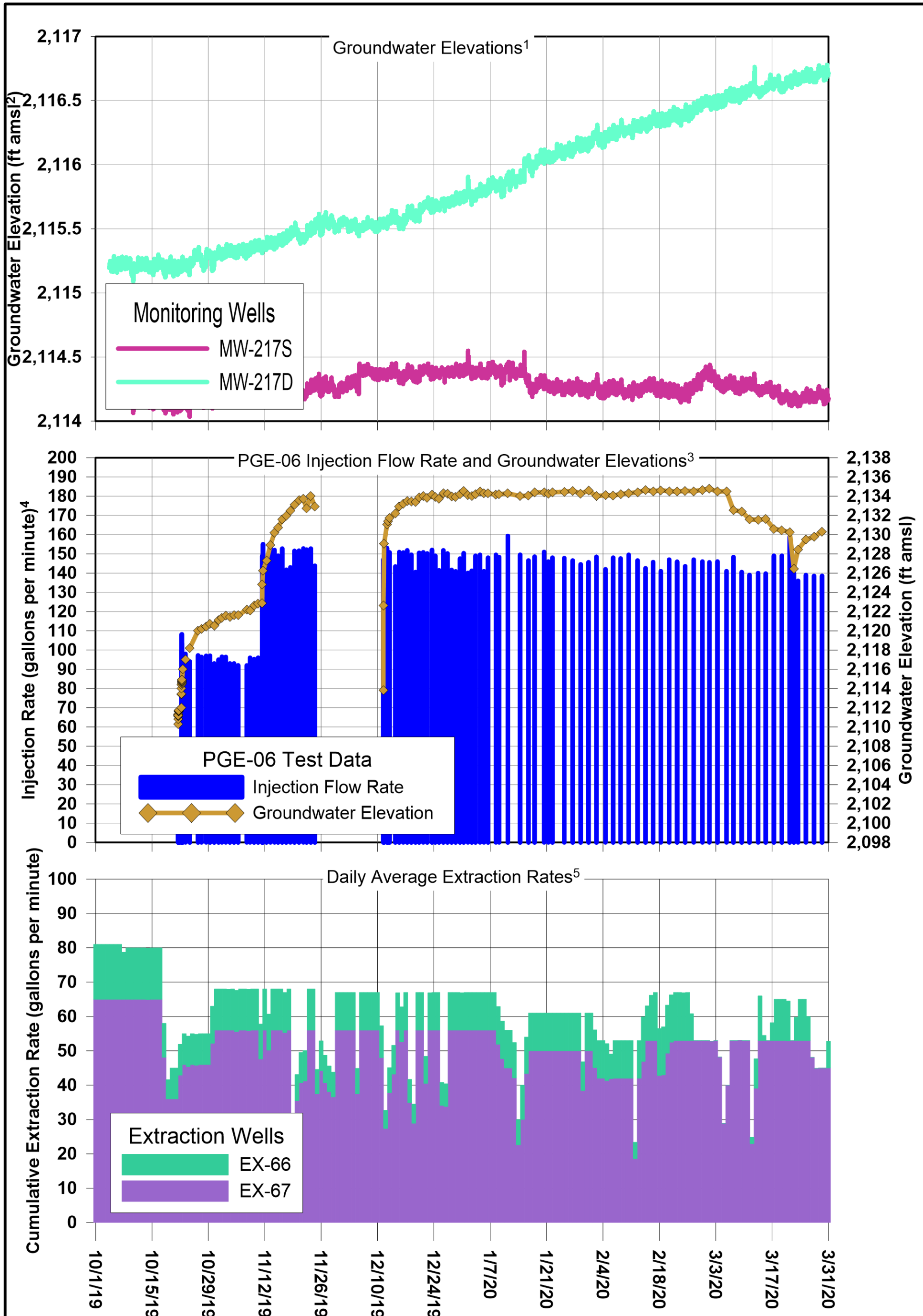
Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals. MW-39D data end on December 2, 2019 due to malfunctioning transducer.
- 2) ft amsl: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 5

Hydraulic Response Monitoring at MW-39 and MW-39D

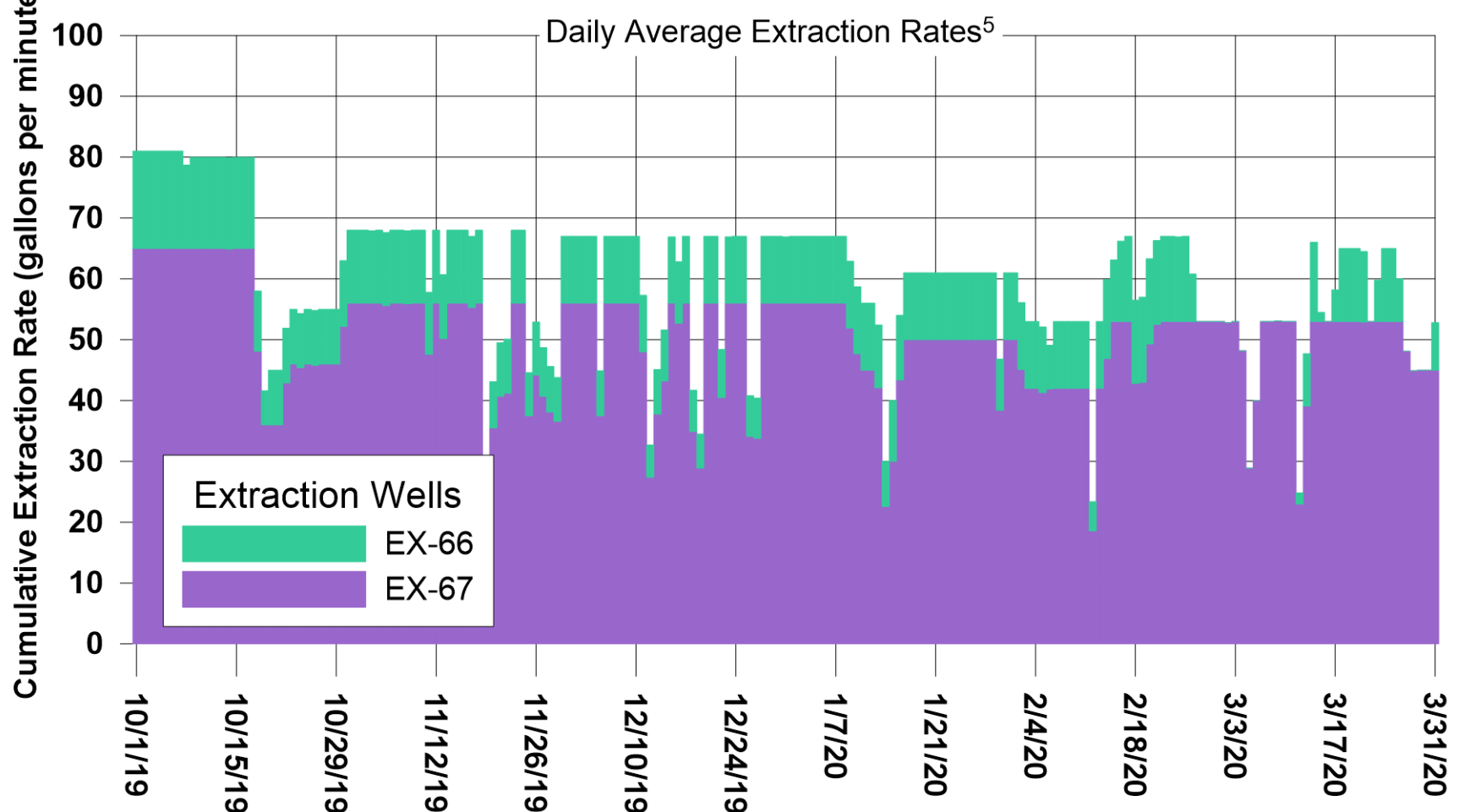
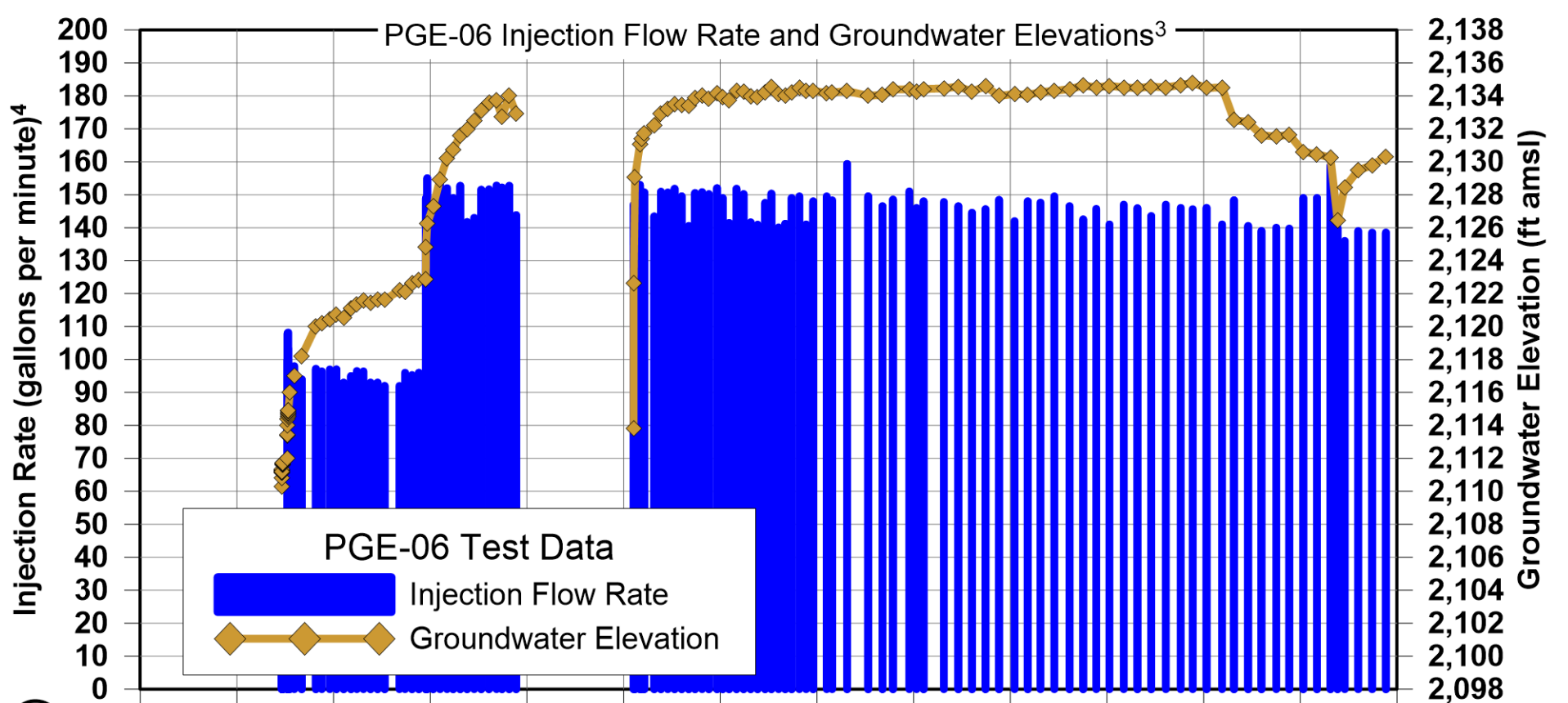
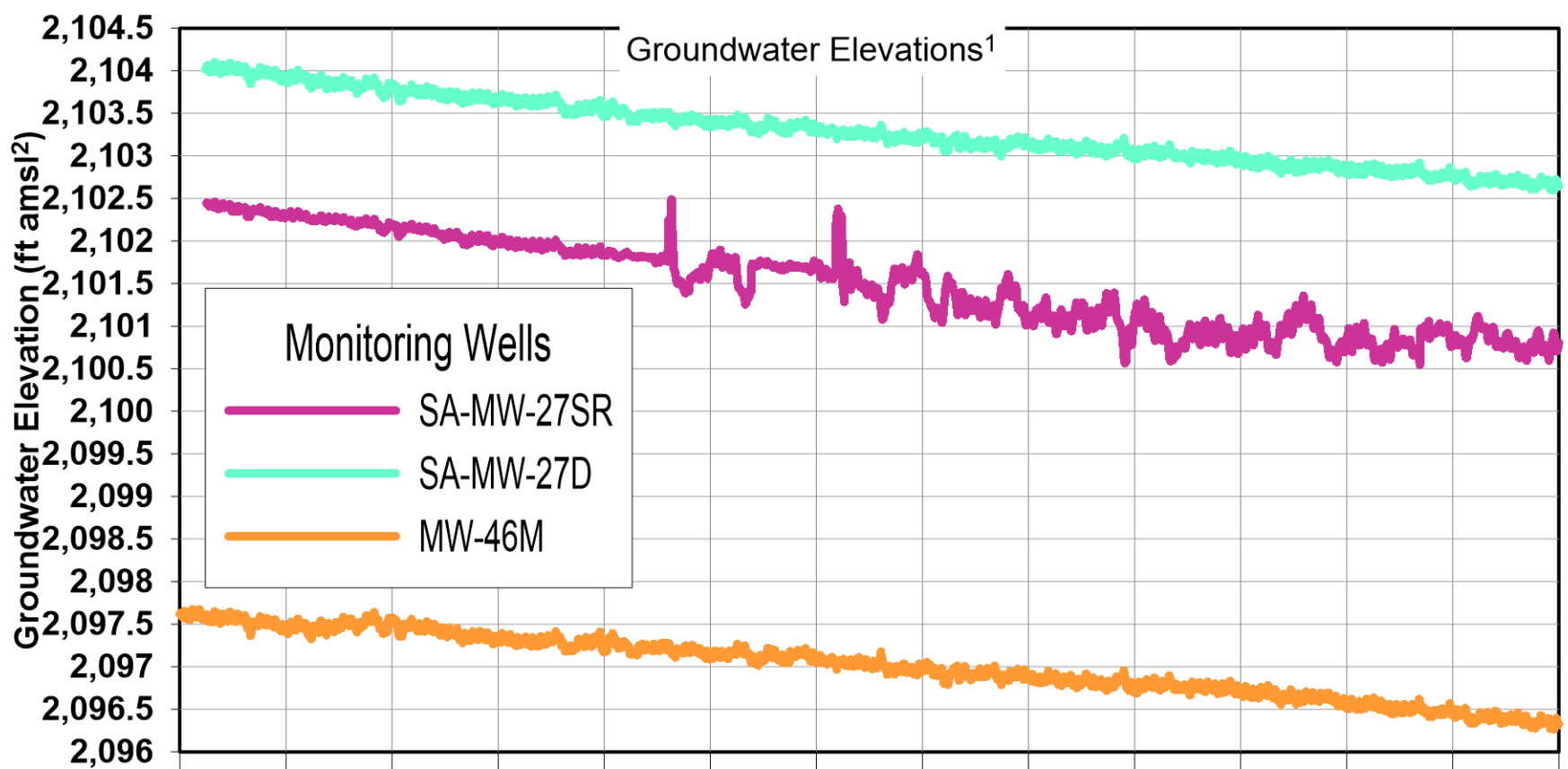
PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft amsl: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

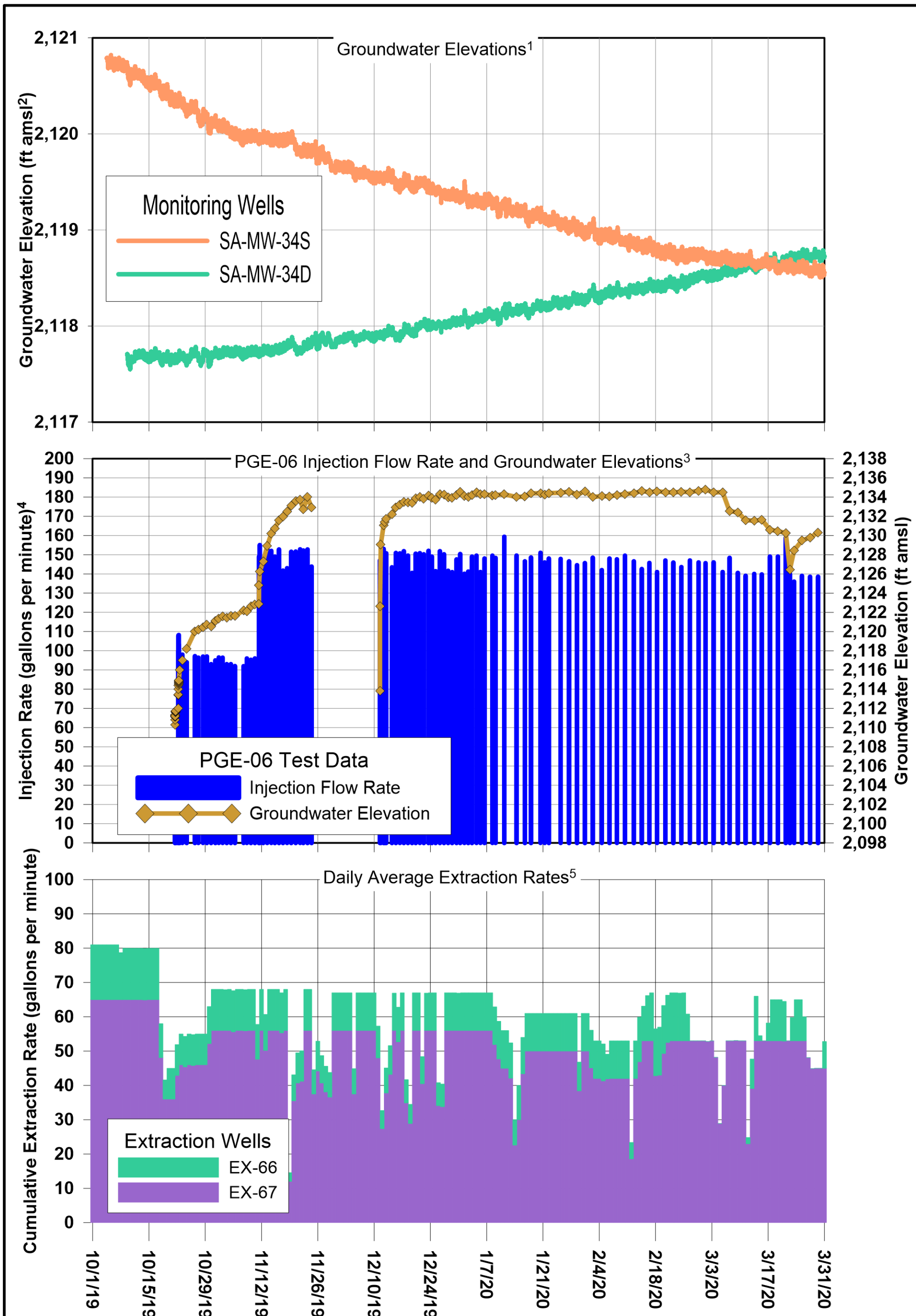
Figure 6
Hydraulic Response Monitoring
at MW-217S and MW-217D
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft amsl: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

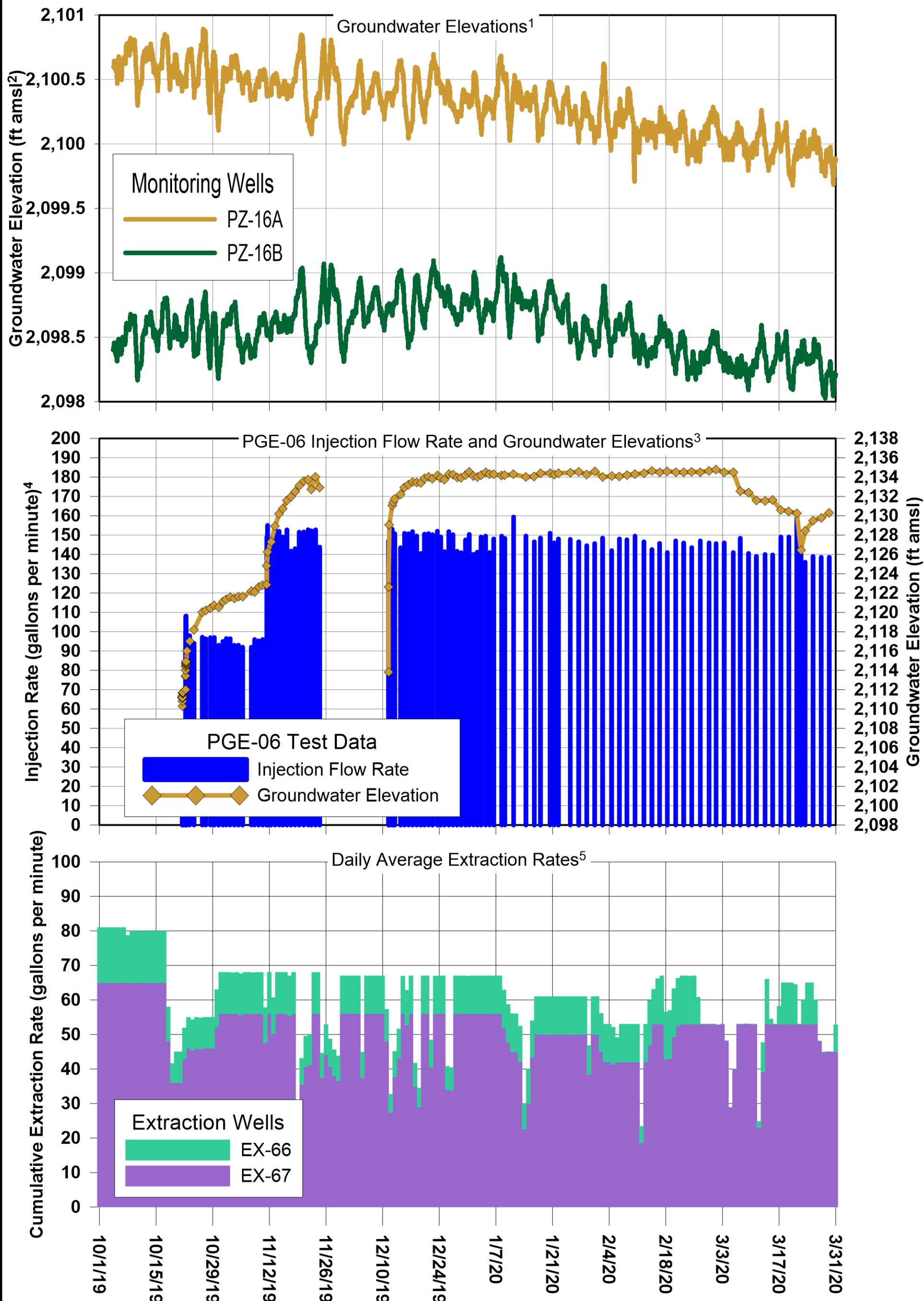
Figure 7
Hydraulic Response Monitoring
at MW-46M, SA-MW-27SR, and SA-MW-27D
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft amsl: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 8
Hydraulic Response Monitoring
at SA-MW-34S and SA-MW-34D
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA

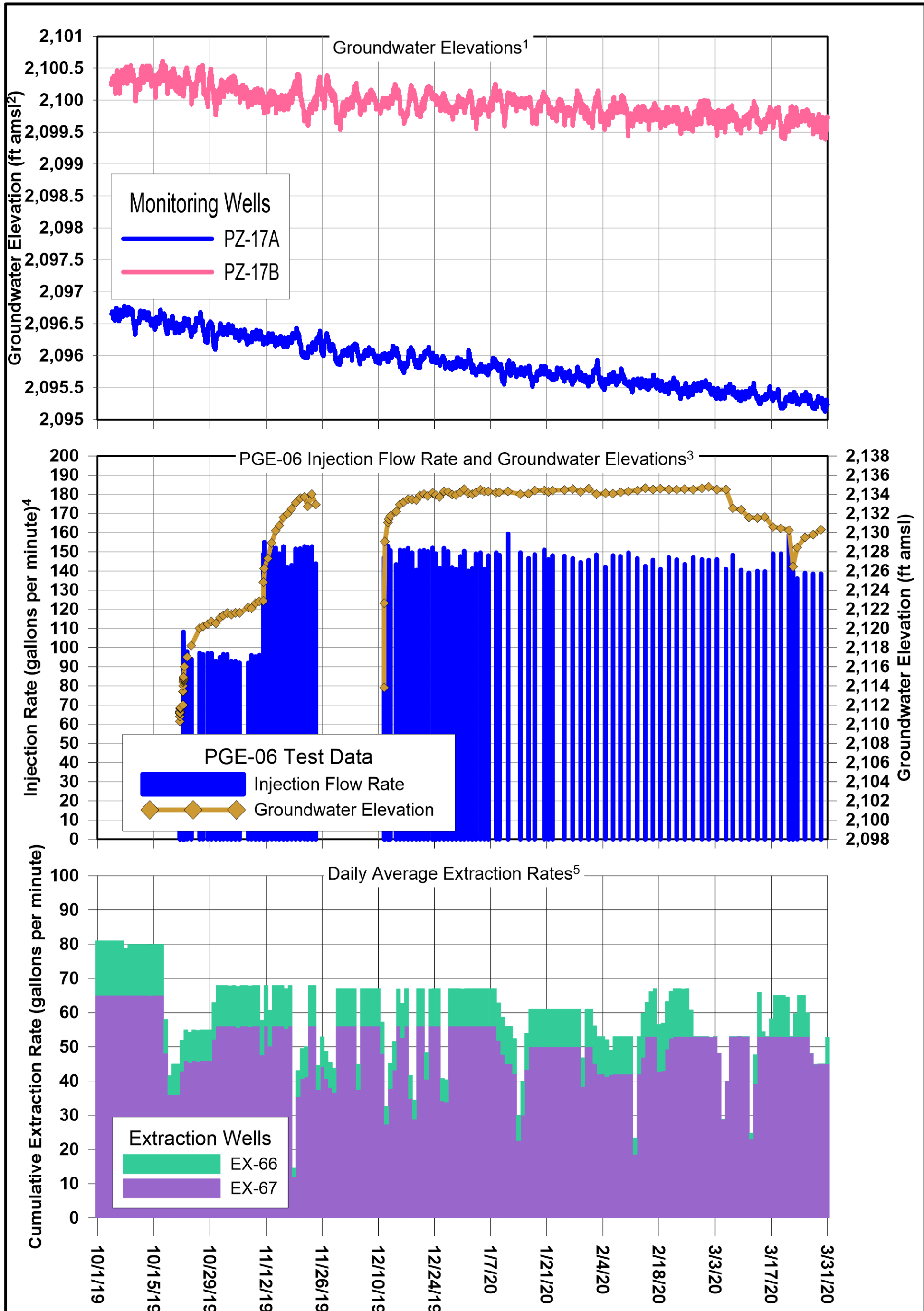


Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft ASML: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 9
Hydraulic Response Monitoring
at PZ-16A and PZ-16B

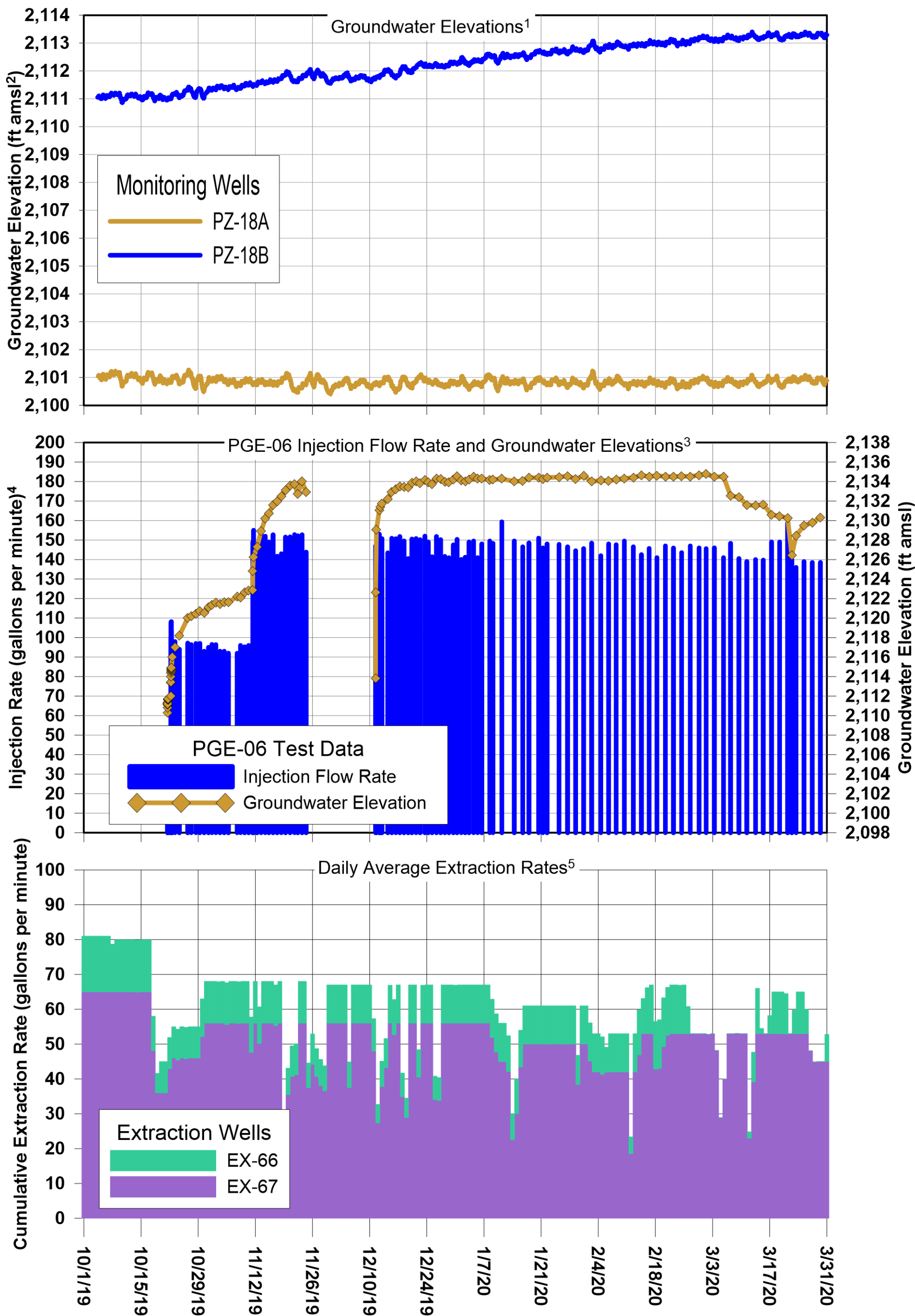
PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
PACIFIC GAS & ELECTRIC COMPANY,
HINKLEY COMPRESSOR STATION,
HINKLEY CALIFORNIA



Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft ASML: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

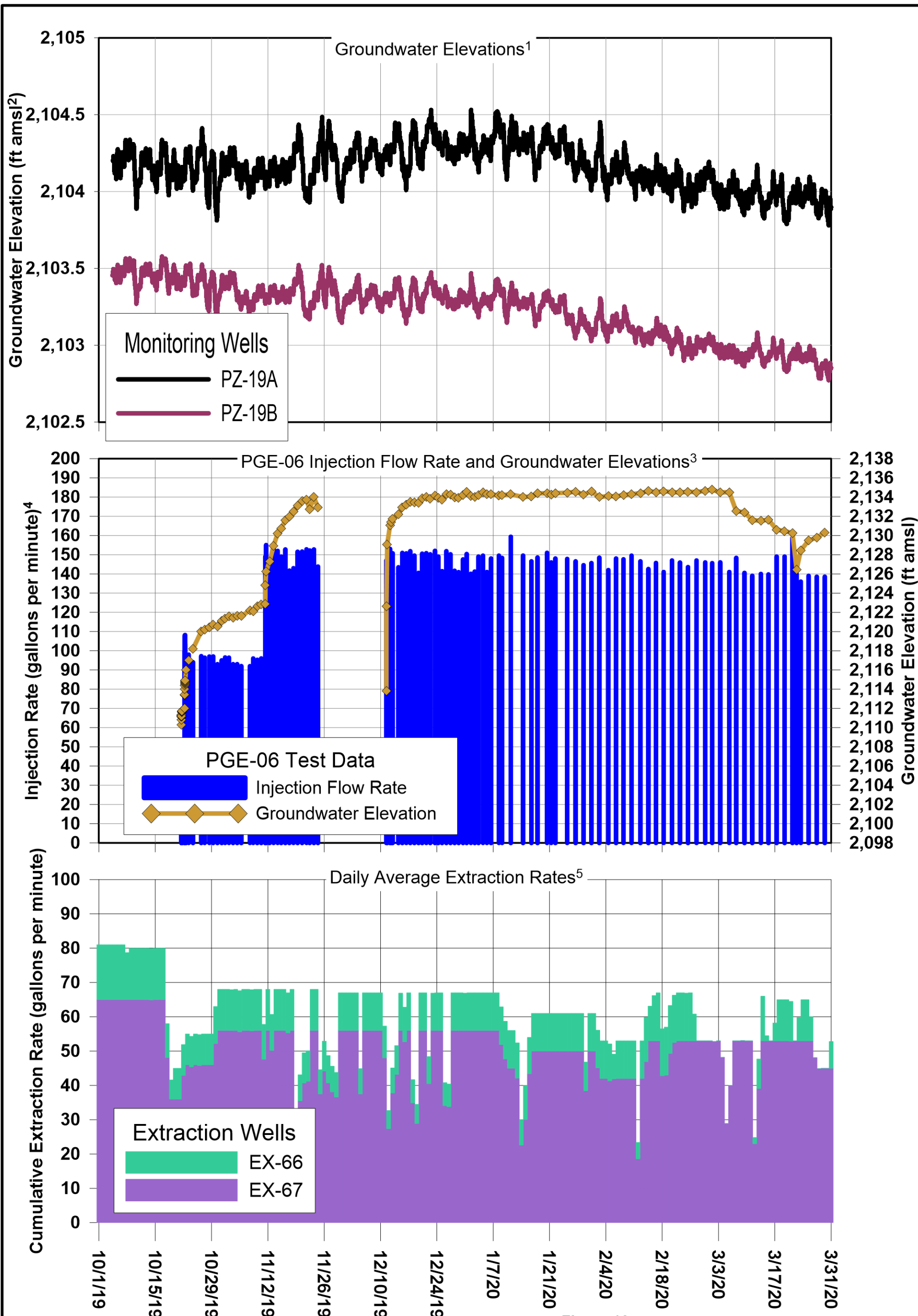
Figure 10
Hydraulic Response Monitoring
at PZ-17A and PZ-17B
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft amsl: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 11
Hydraulic Response Monitoring
at PZ-18A and PZ-18B
 PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



Notes:

- 1) Data are measurements from pressure transducers programmed to record at 30-minute intervals.
- 2) ft ASML: Feet Above Mean Sea Level
- 3) PGE-06 groundwater elevations are manual measurements.
- 4) Freshwater injections at PGE-06 began on October 21, 2019 until November 24, 2019. Injections resumed on December 11, 2019 until March 31, 2020.
- 5) Data are daily average flow rates for extraction wells recorded and calculated using supervisory control and data acquisition.

Figure 12

Hydraulic Response Monitoring at PZ-19A and PZ-19B

PGE-06 FRESHWATER INJECTION PILOT TEST RESULTS
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA

ATTACHMENT 1

FW-01 Through FW-04 Water Supply Well Analytical Results



Table I-2
FW-01 Through FW-04 Water Supply Well Analytical Results
Third Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Sample Date	Sample Type	Method	Parameter	Result	Units
FW-01	7/16/2019		EPA 900.0	Gross Alpha	3.53 J	pCi/L
			EPA 900.0	Gross Beta	3.6	pCi/L
			EPA 218.6	Hexavalent Chromium	0.75	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	ND (0.02)	mg/L
			SW 6020	Manganese, Dissolved	0.0017	mg/L
			EPA 300.0	Nitrate as Nitrogen	0.98	mg/L
			EPA 300.0	Sulfate	45	mg/L
			SM 2540 C	Total Dissolved Solids	290	mg/L
			EPA 200.8	Uranium, Dissolved	1.9	pCi/L
FW-02	7/16/2019		EPA 900.0	Gross Alpha	3.44 J	pCi/L
			EPA 900.0	Gross Beta	3.06	pCi/L
			EPA 218.6	Hexavalent Chromium	0.92	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	ND (0.02)	mg/L
			SW 6020	Manganese, Dissolved	0.0019	mg/L
			EPA 300.0	Nitrate as Nitrogen	1.2	mg/L
			EPA 300.0	Sulfate	46	mg/L
			SM 2540 C	Total Dissolved Solids	300	mg/L
			EPA 200.8	Uranium, Dissolved	3.0	pCi/L
FW-03	7/16/2019		EPA 900.0	Gross Alpha	1.8 J	pCi/L
			EPA 900.0	Gross Beta	2.27	pCi/L
			EPA 218.6	Hexavalent Chromium	ND (0.2)	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	ND (0.02)	mg/L
			SW 6020	Manganese, Dissolved	ND (0.0005)	mg/L
			EPA 300.0	Nitrate as Nitrogen	1.3	mg/L
			EPA 300.0	Sulfate	39	mg/L
			SM 2540 C	Total Dissolved Solids	260	mg/L
			EPA 200.8	Uranium, Dissolved	0.95	pCi/L
FW-04	7/16/2019		EPA 900.0	Gross Alpha	ND (1.57 J)	pCi/L
			EPA 900.0	Gross Beta	2.18	pCi/L
			EPA 218.6	Hexavalent Chromium	ND (0.2)	µg/L

Table I-2
FW-01 Through FW-04 Water Supply Well Analytical Results
Third Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Sample Date	Sample Type	Method	Parameter	Result	Units
FW-04	7/16/2019		SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	ND (0.02)	mg/L
			SW 6020	Manganese, Dissolved	ND (0.0005)	mg/L
			EPA 300.0	Nitrate as Nitrogen	1.2	mg/L
			EPA 300.0	Sulfate	37	mg/L
			SM 2540 C	Total Dissolved Solids	250	mg/L
			EPA 200.8	Uranium, Dissolved	0.75	pCi/L

Notes:

µg/L = micrograms per liter

mg/L = milligrams per liter

ND (x.x) = parameter is not detected at the reporting limit shown

pCi/L = picocuries per liter

Table J-2

FW-01 Through FW-04 Water Supply Well Analytical Results
First Quarter 2020 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Sample Date	Sample Type	Method	Parameter	Result	Units
FW-01	1/15/2020		EPA 218.6	Hexavalent Chromium	0.72	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	0.068	mg/L
			SW 6020	Manganese, Dissolved	0.0021	mg/L
			EPA 300.0	Nitrate as Nitrogen	0.92	mg/L
			EPA 300.0	Sulfate	43	mg/L
			SM 2540 C	Total Dissolved Solids	270	mg/L
			EPA 200.8	Uranium, Dissolved	1.9	pCi/L
FW-01	1/15/2020	FD	EPA 218.6	Hexavalent Chromium	0.71	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	0.1	mg/L
			SW 6020	Manganese, Dissolved	0.002	mg/L
			EPA 300.0	Nitrate as Nitrogen	0.92	mg/L
			EPA 300.0	Sulfate	42	mg/L
			SM 2540 C	Total Dissolved Solids	280	mg/L
			EPA 200.8	Uranium, Dissolved	1.9	pCi/L
FW-02	1/15/2020		EPA 218.6	Hexavalent Chromium	0.91	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	0.18 J	mg/L
			SW 6020	Manganese, Dissolved	0.0023	mg/L
			EPA 300.0	Nitrate as Nitrogen	1.0	mg/L
			EPA 300.0	Sulfate	46	mg/L
			SM 2540 C	Total Dissolved Solids	290	mg/L
			EPA 200.8	Uranium, Dissolved	2.9	pCi/L
FW-03	1/16/2020		EPA 218.6	Hexavalent Chromium	ND (0.2)	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	0.22	mg/L
			SW 6020	Manganese, Dissolved	ND (0.0005)	mg/L
			EPA 300.0	Nitrate as Nitrogen	1.0	mg/L
			EPA 300.0	Sulfate	37	mg/L
			SM 2540 C	Total Dissolved Solids	260	mg/L
			EPA 200.8	Uranium, Dissolved	0.99	pCi/L
FW-03	1/16/2020	FD	EPA 218.6	Hexavalent Chromium	0.2	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	0.16	mg/L

Table J-2

**FW-01 Through FW-04 Water Supply Well Analytical Results
First Quarter 2020 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California**

Location	Sample Date	Sample Type	Method	Parameter	Result	Units
FW-03	1/16/2020	FD	SW 6020	Manganese, Dissolved	ND (0.0005)	mg/L
			EPA 300.0	Nitrate as Nitrogen	0.99	mg/L
			EPA 300.0	Sulfate	37	mg/L
			SM 2540 C	Total Dissolved Solids	260	mg/L
			EPA 200.8	Uranium, Dissolved	1.0	pCi/L
FW-04	1/15/2020		EPA 218.6	Hexavalent Chromium	0.24	µg/L
			SW 6020	Total Dissolved Chromium	ND (1.0)	µg/L
			SW 6010B	Iron, Dissolved	0.17	mg/L
			SW 6020	Manganese, Dissolved	ND (0.0005)	mg/L
			EPA 300.0	Nitrate as Nitrogen	1.0	mg/L
			EPA 300.0	Sulfate	47	mg/L
			SM 2540 C	Total Dissolved Solids	270	mg/L
			EPA 200.8	Uranium, Dissolved	1.7	pCi/L

Notes:

µg/L = micrograms per liter

mg/L = milligrams per liter

ND (x.x) = parameter is not detected at the reporting limit shown

pCi/L = picocuries per liter